

CLAIMS

1. A fuel cell system, comprising:

a fuel cell (1) that has an electrolyte membrane and generates power by using a fuel

5 gas and an oxidizing agent gas;

a storage device (51) for water that humidifies the fuel cell (1), and

a controller (100) that functions to:

judge whether the fuel cell (1) can be humidified by using the water of the storage device (51), and

10 limit the operating temperature of the fuel cell (1) to below a limit temperature that is lower than during normal operation in a case where it is judged that the fuel cell (1) cannot be humidified.

2. The fuel cell system as defined in claim 1,

15 wherein the controller (100) further functions to:

judges whether the water in the storage device (51) is present in the liquid phase in a predetermined amount or more, and

limits the operating temperature of the fuel cell (1) to below the limit temperature in a case where the liquid-phase water is not present in the predetermined amount or more.

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3. The fuel cell system as defined in claim 1, further comprising:

a thawing device (60a) that thaws freezing water in the storage device (51); and

a detection device (118) that detects the state of the water in the storage device (51),

wherein the controller (100) further functions to:

judge whether water of at least a predetermined amount is in the liquid phase in the storage device (51), and

limit the operating temperature of the fuel cell (1) to below the limit temperature in a case where the water in the storage device (51) is freezing and it is judged that the liquid-phase water does not satisfy the predetermined amount, and cancel the limit on the operating temperature of the fuel cell (1) upon judging that water of at least the 5 predetermined amount is in the liquid phase in the storage device (51).

4. The fuel cell system as defined in claim 2, further comprising:
a discharge device (74) for discharging the water in the storage device (51); and
a water amount detection device (151) that detects the amount of water in the storage 10 device (51),

wherein the controller (100) further functions to:

predict whether there is a possibility of the water in the storage device (51) freezing,
discharge the water in the storage device (51) in a case where it is judged that there is
a possibility of the water in the storage device (51) freezing, and

15 limit the operating temperature of the fuel cell (1) at startup of the fuel cell (1) to below
the limit temperature until water in the storage device (51) has accumulated in the
predetermined amount or more.

5. The fuel cell system as defined in claim 1, further comprising:
20 a cooling system having a coolant pump (52) that pressure-feeds a coolant that
exchanges heat with the fuel cell (1) and a radiator (50) that performs coolant heat radiation,
wherein the controller (100) further functions to:
maximize the coolant flow rate circulated in the radiator (50) when the temperature of
the coolant discharged by the fuel cell (1) is the limit temperature, in a case where the
25 temperature of the fuel cell (1) is limited to below the limit temperature.

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6. The fuel cell system as defined in claim 5, wherein the controller (100) further functions to:

control the temperature of the fuel cell (1) by limiting the output of the fuel cell (1).

5 7. The fuel cell system as defined in claim 6, wherein the controller (100) further functions to:

preferentially increase the coolant flow rate to the radiator (50) when the operating temperature of the fuel cell (1) is limited, and

10 limit the output of the fuel cell (1) in a case where the operating temperature of the fuel cell (1) also exceeds the limit temperature after the coolant circulation flow rate to the radiator (50) has reached a maximum.

8. The fuel cell system as defined in claim 6, further comprising:

15 a radiator fan (50a) that increases and decreases the flow rate of an air stream that passes through the radiator (50),

wherein the controller (100) further functions to:

preferentially increase the motive power of the radiator fan (50a) when the operating temperature of the fuel cell (1) is limited, and

20 limit the output of the fuel cell (1) in a case where the operating temperature of the fuel cell (1) also exceeds the limit temperature after the motive power of the radiator fan (50a) has reached a maximum.

9. The fuel cell system as defined in claim 6, further comprising:

25 a radiator fan (50a) that increases and decreases the flow rate of an air stream that passes through the radiator (50),

wherein the controller (100) further functions to:

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limit the output of the fuel cell (1) in a case where the fuel cell (1) also exceeds the limit temperature after the coolant flow rate to the radiator (50) and the motive power of the radiator fan (50a) have both reached a maximum, when the operating temperature of the fuel cell (1) is limited.

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10. The fuel cell system as defined in claim 3, further comprising:

a water temperature detection device (118) that senses the temperature of the water in the storage device (51),

wherein the controller (100) further functions to:

10 judge that water of a predetermined amount or more in the storage device (51) is in the liquid phase in a case where the temperature of the water in the storage device (51) is at a predetermined temperature that exceeds 0°C.

11. The fuel cell system as defined in claim 1, further comprising:

15 a pressure regulation device (18, 43) that regulates the operating pressure of the fuel cell (1),

wherein the controller (100) further functions to:

increases the operating pressure of the fuel cell (1) in a case where it is judged that the fuel cell cannot be humidified.

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12. The fuel cell system as defined in claim 11, wherein the controller (100) further functions to:

increase the operating pressure of the fuel cell (1) in accordance with a rise in the operating temperature of the fuel cell (1) in a case where it is judged that the fuel cell (1) cannot be humidified, and operate the fuel cell (1) at maximum pressure when the temperature of the fuel cell (1) has reached the limit temperature.

13. The fuel cell system as defined in claim 3, further comprising:
a combustion device (30) that burns a hydrogen-containing gas and an oxidizing agent gas; and

5 a cooling system that circulates a coolant in the combustion device (30), the fuel cell (1), and the storage device (51) in that order,

wherein the controller (100) further functions to:

supply the heat generated by the combustion device (30) to the fuel cell (1) via the coolant when warming up the fuel cell (1), and

10 warm up the storage device (51) by supplying the heat that accompanies the power generation of the fuel cell (1) to the storage device (51) via the coolant after the warming-up of the fuel cell (1) is complete and the combustion device (30) has been stopped.

14. A startup method for a fuel cell system that comprises a fuel cell (1) that has an electrolyte membrane and generates power by using a fuel gas and an oxidizing agent gas; and a storage device (51) for water that humidifies the fuel cell, said method comprising:

judging whether the fuel cell (1) can be humidified by using the water of the storage device (51), and

20 limiting the operating temperature of the fuel cell (1) to below a limit temperature that is lower than during normal operation in a case where it is judged that the fuel cell (1) cannot be humidified.

15. A fuel cell system, comprising:

25 a fuel cell (1) that has an electrolyte membrane and generates power by using a fuel gas and an oxidizing agent gas;

a storage device (51) for water that humidifies the fuel cell (1),

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means for judging whether the fuel cell (1) can be humidified by using the water of the storage device (51), and

means for limiting the operating temperature of the fuel cell (1) to below a limit temperature that is lower than during normal operation in a case where it is judged that the
5 fuel cell (1) cannot be humidified.